GENERIC CALCULATION OF RE-USE DISTANCES ASSUMING 50' MAXIMUM RANGE

General Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Speed of Light	Cf	984251969	feet/sec.
	Wavelength	Lambda	0.1682482	feet
	Wavelength in dB	Lambda_dB	-7.74	dB feet
	4*PI	F_PI	10.99	dB
	Maximum Operating Range	Rmax	**50.00**	feet
	Maximum Operating Range in dB	Rmax_dB	16.99	dB feet
RSU	Antenna Gain	RSU_g	**20.00**	dB
	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	5.00	dB
	Minimum Received Signal Level (rcvr.)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level (rcvr.)	RSU_int	**-114.00**	dBm
	Maximum Transmit EIRP	RSU_Pmax	35	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant)	OBU_max	**-14.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Maximum Interference Signal Level (0 dB ant)	OBU_int	**-60.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

GENERIC CALCULATION OF RE-USE DISTANCES ASSUMING 50' MAXIMUM RANGE EIRP (CONTINUED)

Uplink on Uplink Separation Distance OBU to RSU

RSU Antenna	**Antennas** SCENARIO	LABEL	VALUE	UNITS
Mainlobe	Same Channel		4,233.90	feet
	Adjacent Channel		533.02	feet
Sidelobe	Same Channel		752.91	feet
	Adjacent Channel		94.79	feet

Downlink on Uplink Separation Distance RSU to RSU

RSU Antenna	**Antennas** SCENARIO	LABEL	VALUE	UNITS
Mainlobe	Tone to Lower Uplink Band		671.03	feet
	Tone to Upper Uplink Band		671.03	feet
	Tone to Adjacent Channel		67.10	feet
	Class A: Modulated to Lower Uplink Band		6,710.28	feet
	Class A: Modulated to Upper Uplink Band		671.03	feet
	Class A: Modulated to Adjacent Channel		475.05	feet
	Class B: Modulated to Lower Uplink Band		2,121.98	feet
	Class B: Modulated to Upper Uplink Band		671.03	feet
	Class B: Modulated to Adjacent Channel		212.20	feet
	Class C: Modulated to Lower Uplink Band		671.03	feet
	Class C: Modulated to Upper Uplink Band		671.03	feet
	Class C: Modulated to Adjacent Channel		67.10	feet
Sidelobe	Tone to Lower Uplink Band		119.33	feet
	Tone to Upper Uplink Band		119.33	feet
	Tone to Adjacent Channel		11.93	feet
	Class A: Modulated to Lower Uplink Band		1,193.28	feet
	Class A: Modulated to Upper Uplink Band		119.33	feet
	Class A: Modulated to Adjacent Channel		84.48	feet
	Class B: Modulated to Lower Uplink Band		377.35	feet
	Class B: Modulated to Upper Uplink Band		119.33	feet
	Class B: Modulated to Adjacent Channel		37.73	feet
	Class C: Modulated to Lower Uplink Band		119.33	feet
	Class C: Modulated to Upper Uplink Band		119.33	feet
	Class C: Modulated to Adjacent Channel		11.93	feet

Downlink on Downlink Separation Distance RSU to OBU

RSU Antenna	**Antennas** SCENARIO	LABEL	VALUE	UNITS
Mainlobe	Same Channel		752.91	feet
	Tone - Adjacent Channel		0.08	feet
	Class A: Modulated - Adjacent Channel		0.53	feet
	Class B: Modulated - Adjacent Channel		0.24	feet
	Class C: Modulated - Adjacent Channel		0.08	feet
Sidelobe	Same Channel		133.89	feet
	Tone - Adjacent Channel		0.01	feet
	Class A: Modulated - Adjacent Channel		0.09	feet
	Class B: Modulated - Adjacent Channel		0.04	feet
	Class C: Modulated - Adjacent Channel		0.01	feet

Uplink on Downlink Separation Distance OBU to OBU

RSU Antenna	**Antennas** SCENARIO	LABEL	VALUE	UNITS
N/A	Same Channel		0.84	feet
	Adjacent Channel		0.11	feet

APPENDIX B-1
IN-VEHICLE SIGNING VERSUS EXIT BEACON
CALCULATIONS OF MINIMUM SEPARATION DISTANCES
ASSUMING 50' RANGE IN-VEHICLE SIGNING BEACONS

CALCULATIONS OF RE-USE DISTANCES: IN-VEHICLE SIGNING (1) TO EXIT BEACON (2)

Beacon Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Speed of Light	Cf	984251969	feet/sec.
	Wavelength	Lambda	**0.1682482**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*PI	F_PI	10.99	dB
Beacon 1 (In-Vehicle Signing Beacon)	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**50.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang_min	**45.00**	degrees
	Minimum Lateral Separation Distance	Sep_min	15.00	feet
	Maximum Operating Range	Rmax	52.20	feet
	Maximum Operating Range in dB	Rmax_dB	17.18	dB feet
	Minimum Operating Range	Rmin	21.21	feet
	Minimum Operating Range in dB	Rmin_dB	13.27	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**12.00**	feet
	Antenna Elevation Beamwidth	RSU_el	28.30	degrees
	Antenna Azimuth Beamwidth	RSU_az	13.11	degrees
	Antenna Gain	RSU_g	19.76	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	4.76	dB
Beacon 2 (Exit Beacon)	Height of RSU Antenna	RSU2_h	**20.00**	feet
	Height of OBU Antenna	OBU2_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep2_max	**15.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang2_min	**-45.00**	degrees
	Minimum Lateral Separation Distance	Sep2_min	-15.00	feet
	Maximum Operating Range	Rmax2	21.21	feet
	Maximum Operating Range in dB	Rmax2_dB	13.27	dB feet
	Minimum Operating Range	Rmin2	**12.00**	feet
	Minimum Operating Range in dB	Rmin2_dB	10.79	dB feet
	Width of Antenna Beam at Longest Range	Wmax2	**5.00**	feet
	Antenna Elevation Beamwidth	RSU2_el	90.00	degrees
	Antenna Azimuth Beamwidth	RSU2_az	13.44	degrees
	Antenna Gain	RSU2_g	14.62	dB
	Maximum Antenna Gain Through Sidelobes	RSU2_gsl	-0.38	dB
RSU General	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Minimum Received Signal Level (at receiver)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB

CALCULATIONS OF RE-USE DISTANCES: IN-VEHICLE SIGNING (1) TO EXIT BEACON (2) (CONTINUED)

OBU Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant.)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant.)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant.)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

Beacon 1 Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	15.06	dBm
	Transmit Power for Successful Uplink	Pt_u	11.13	dBm
	Transmit Power for Up and Down Link	Pt	15.06	dBm
	Transmit EIRP	RSU_EIRP	34.82	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-29.18	dBm

Beacon 2 Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt2_d	12.37	dBm
	Transmit Power for Successful Uplink	Pt2_u	5.75	dBm
	Transmit Power for Up and Down Link	Pt2	12.37	dBm
	Transmit EIRP	RSU2_EIRP	27.00	dBm
OBU	Max. Received Signal Level (0 dB ant.)	BU2_Rma	-32.05	dBm

CALCULATIONS OF RE-USE DISTANCES: IN-VEHICLE SIGNING (1) TO EXIT BEACON (2) (CONTINUED)

Uplink on Uplink Separation Distance OBU to RSU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
Sidelobe	Same Channel	515.21	397.22	feet
	Adjacent Channel	64.86	50.01	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
Sidelobe	Tone to Lower Uplink Band	46.18	62.93	feet
	Tone to Upper Uplink Band	46.18	62.93	feet
	Tone to Adjacent Channel	4.62	6.29	feet
	Class A: Modulated to Lower Uplink Band	461.77	629.35	feet
	Class A: Modulated to Upper Uplink Band	46.18	62.93	feet
	Class A: Modulated to Adjacent Channel	32.69	44.55	feet
	Class B: Modulated to Lower Uplink Band	146.02	199.02	feet
	Class B: Modulated to Upper Uplink Band	46.18	62.93	feet
	Class B: Modulated to Adjacent Channel	14.60	19.90	feet
	Class C: Modulated to Lower Uplink Band	46.18	62.93	feet
	Class C: Modulated to Upper Uplink Band	46.18	62.93	feet
	Class C: Modulated to Adjacent Channel	4.62	6.29	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
Sidelobe	Same Channel	53.29	131.12	feet
	Tone - Adjacent Channel	0.01	0.01	feet
	Class A: Modulated - Adjacent Channel	0.04	0.09	feet
	Class B: Modulated - Adjacent Channel	0.02	0.04	feet
	Class C: Modulated - Adjacent Channel	0.01	0.01	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
N/A	Same Channel	0.59	0.83	feet
	Adjacent Channel	0.07	0.10	feet

APPENDIX B-2
IN-VEHICLE SIGNING VERSUS EXIT BEACON CALCULATIONS OF MINIMUM SEPARATION DISTANCES ASSUMING 100' RANGE IN-VEHICLE SIGNING BEACONS

CALCULATIONS OF RE-USE DISTANCES: IN-VEHICLE SIGNING (1) TO EXIT BEACON (2)

Beacon Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Speed of Light	Cf	984251969	feet/sec.
	Wavelength	Lambda	**0.1682482**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*PI	F_PI	10.99	dB
Beacon 1 (In-Vehicle Signing Beacon)	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**100.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang_min	**45.00**	degrees
	Minimum Lateral Separation Distance	Sep_min	15.00	feet
	Maximum Operating Range	Rmax	101.12	feet
	Maximum Operating Range in dB	Rmax_dB	20.05	dB feet
	Minimum Operating Range	Rmin	21.21	feet
	Minimum Operating Range in dB	Rmin_dB	13.27	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**12.00**	feet
	Antenna Elevation Beamwidth	RSU_el	36.47	degrees
	Antenna Azimuth Beamwidth	RSU_az	6.79	degrees
	Antenna Gain	RSU_g	21.51	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	6.51	dB
Beacon 2 (Exit Beacon)	Height of RSU Antenna	RSU2_h	**20.00**	feet
	Height of OBU Antenna	OBU2_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep2_max	**15.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang2_min	**-45.00**	degrees
	Minimum Lateral Separation Distance	Sep2_min	-15.00	feet
	Maximum Operating Range	Rmax2	21.21	feet
	Maximum Operating Range in dB	Rmax2_dB	13.27	dB feet
	Minimum Operating Range	Rmin2	**12.00**	feet
	Minimum Operating Range in dB	Rmin2_dB	10.79	dB feet
	Width of Antenna Beam at Longest Range	Wmax2	**5.00**	feet
	Antenna Elevation Beamwidth	RSU2_el	90.00	degrees
	Antenna Azimuth Beamwidth	RSU2_az	13.44	degrees
	Antenna Gain	RSU2_g	14.62	dB
	Maximum Antenna Gain Through Sidelobes	RSU2_gsl	-0.38	dB
RSU General	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Minimum Received Signal Level (at receiver)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB

CALCULATIONS OF RE-USE DISTANCES: IN-VEHICLE SIGNING (1) TO EXIT BEACON (2) (CONTINUED)

OBU Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant.)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant.)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant.)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

Beacon 1 Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	19.05	dBm
	Transmit Power for Successful Uplink	Pt_u	19.10	dBm
	Transmit Power for Up and Down Link	Pt	19.10	dBm
	Transmit EIRP	RSU_EIRP	40.61	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-23.39	dBm

Beacon 2 Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt2_d	12.37	dBm
	Transmit Power for Successful Uplink	Pt2_u	5.75	dBm
	Transmit Power for Up and Down Link	Pt2	12.37	dBm
	Transmit EIRP	RSU2_EIRP	27.00	dBm
OBU	Max. Received Signal Level (0 dB ant.)	BU2_Rma	-32.05	dBm

CALCULATIONS OF RE-USE DISTANCES: IN-VEHICLE SIGNING (1) TO EXIT BEACON (2) (CONTINUED)

Uplink on Uplink Separation Distance OBU to RSU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
Sidelobe	Same Channel	630.66	405.46	feet
	Adjacent Channel	79.40	51.04	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
Sidelobe	Tone to Lower Uplink Band	56.52	122.60	feet
	Tone to Upper Uplink Band	56.52	122.60	feet
	Tone to Adjacent Channel	5.65	12.26	feet
	Class A: Modulated to Lower Uplink Band	565.24	1,226.03	feet
	Class A: Modulated to Upper Uplink Band	56.52	122.60	feet
	Class A: Modulated to Adjacent Channel	40.02	86.80	feet
	Class B: Modulated to Lower Uplink Band	178.75	387.71	feet
	Class B: Modulated to Upper Uplink Band	56.52	122.60	feet
	Class B: Modulated to Adjacent Channel	17.87	38.77	feet
	Class C: Modulated to Lower Uplink Band	56.52	122.60	feet
	Class C: Modulated to Upper Uplink Band	56.52	122.60	feet
	Class C: Modulated to Adjacent Channel	5.65	12.26	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
Sidelobe	Same Channel	53.29	255.44	feet
	Tone - Adjacent Channel	0.01	0.03	feet
	Class A: Modulated - Adjacent Channel	0.04	0.18	feet
	Class B: Modulated - Adjacent Channel	0.02	0.08	feet
	Class C: Modulated - Adjacent Channel	0.01	0.03	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO	2 on 1	1 on 2	UNITS
N/A	Same Channel	0.59	0.84	feet
	Adjacent Channel	0.07	0.11	feet

APPENDIX C-1
IN-VEHICLE SIGNING BEACONS WITH 50' OPERATING RANGE
CALCULATIONS OF MINIMUM SEPARATION DISTANCES

CALCULATION OF RE-USE DISTANCES BETWEEN IN-VEHICLE SIGNING

General Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**50.00**	feet
	Minimum RSU Ant. Angle From Vertical	Ang_min	**45.00**	degrees
	Minimum Lateral Separation Distance	Sep_min	15.00	feet
	Maximum Operating Range	Rmax	52.20	feet
	Maximum Operating Range in dB	Rmax_dB	17.18	dB feet
	Minimum Operating Range	Rmin	21.21	feet
	Minimum Operating Range in dB	Rmin_dB	13.27	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**12.00**	feet
	Speed of Light	Cf	9.84E+08	feet/sec.
	Wavelength	Lambda	**0.168248**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*PI	F_PI	10.99	dB
RSU	Antenna Elevation Beamwidth	RSU_el	28.30	degrees
	Antenna Azimuth Beamwidth	RSU_az	13.11	degrees
	Antenna Gain	RSU_g	19.76	dB
	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	4.76	dB
	Minimum Received Signal Level (at rcvr)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

CALCULATION OF RE-USE DISTANCES BETWEEN IN-VEHICLE SIGNING BEACONS (CONTINUED)

RSU Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	15.06	dBm
	Transmit Power for Successful Uplink	Pt_u	11.13	dBm
	Transmit Power for Up and Down Link	Pt	15.06	dBm
	Transmit EIRP	RSU_EIRP	34.82	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-29.18	dBm

Uplink on Uplink Separation Distance OBU to RSU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Same Channel		717.19	feet
	Adjacent Channel		90.29	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Tone to Lower Uplink Band		113.63	feet
	Tone to Upper Uplink Band		113.63	feet
	Tone to Adjacent Channel		11.36	feet
	Class A: Modulated to Lower Uplink Band		1,136.31	feet
	Class A: Modulated to Upper Uplink Band		113.63	feet
	Class A: Modulated to Adjacent Channel		80.44	feet
	Class B: Modulated to Lower Uplink Band		359.33	feet
	Class B: Modulated to Upper Uplink Band		113.63	feet
	Class B: Modulated to Adjacent Channel		35.93	feet
	Class C: Modulated to Lower Uplink Band		113.63	feet
	Class C: Modulated to Upper Uplink Band		113.63	feet
	Class C: Modulated to Adjacent Channel		11.36	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Same Channel		131.12	feet
	Tone - Adjacent Channel		0.01	feet
	Class A: Modulated - Adjacent Channel		0.09	feet
	Class B: Modulated - Adjacent Channel		0.04	feet
	Class C: Modulated - Adjacent Channel		0.01	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
N/A	Same Channel		0.83	feet
	Adjacent Channel		0.10	feet

APPENDIX C-2
IN-VEHICLE SIGNING BEACONS WITH 100' OPERATING RANGE
CALCULATIONS OF MINIMUM SEPARATION DISTANCES

CALCULATION OF RE-USE DISTANCE BETWEEN IN-VEHICLE SIGNING BEACONS

General Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**100.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang_min	**45.00**	degrees
	Minimum Lateral Separation Distance	Sep_min	15.00	feet
	Maximum Operating Range	Rmax	101.12	feet
	Maximum Operating Range in dB	Rmax_dB	20.05	dB feet
	Minimum Operating Range	Rmin	21.21	feet
	Minimum Operating Range in dB	Rmin_dB	13.27	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**12.00**	feet
	Speed of Light	Cf	9.84E+08	feet/sec.
	Wavelength	Lambda	**0.168248**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*Pl	F_Pl	10.99	dB
RSU	Antenna Elevation Beamwidth	RSU_el	36.47	degrees
	Antenna Azimuth Beamwidth	RSU_az	6.79	degrees
	Antenna Gain	RSU_g	21.51	dB
	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	6.51	dB
	Minimum Received Signal Level (at receiver)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant.)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant.)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant.)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

CALCULATION OF RE-USE DISTANCE BETWEEN IN-VEHICLE SIGNING BEACONS (CONTINUED)

RSU Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	19.05	dBm
	Transmit Power for Successful Uplink	Pt_u	19.10	dBm
	Transmit Power for Up and Down Link	Pt	19.10	dBm
	Transmit EIRP	RSU_EIRP	40.61	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-23.39	dBm

Uplink on Uplink Separation Distance OBU to RSU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Same Channel		896.13	feet
	Adjacent Channel		112.82	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Tone to Lower Uplink Band		270.97	feet
	Tone to Upper Uplink Band		270.97	feet
	Tone to Adjacent Channel		27.10	feet
	Class A: Modulated to Lower Uplink Band		2,709.71	feet
	Class A: Modulated to Upper Uplink Band		270.97	feet
	Class A: Modulated to Adjacent Channel		191.83	feet
	Class B: Modulated to Lower Uplink Band		856.89	feet
	Class B: Modulated to Upper Uplink Band		270.97	feet
	Class B: Modulated to Adjacent Channel		85.69	feet
	Class C: Modulated to Lower Uplink Band		270.97	feet
	Class C: Modulated to Upper Uplink Band		270.97	feet
	Class C: Modulated to Adjacent Channel		27.10	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Same Channel		255.44	feet
	Tone - Adjacent Channel		0.03	feet
	Class A: Modulated - Adjacent Channel		0.18	feet
	Class B: Modulated - Adjacent Channel		0.08	feet
	Class C: Modulated - Adjacent Channel		0.03	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
N/A	Same Channel		0.84	feet
	Adjacent Channel		0.11	feet

APPENDIX D-1
INTERSECTION BEACONS WITH 50' OPERATING RANGE
CALCULATIONS OF MINIMUM SEPARATION DISTANCES

CALCULATION OF RE-USE DISTANCE BETWEEN INTERSECTION BEACONS

General Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**50.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang_min	**30.00**	degrees
	Minimum Lateral Separation Distance	Sep_min	8.66	feet
	Maximum Operating Range	Rmax	52.20	feet
	Maximum Operating Range in dB	Rmax_dB	17.18	dB feet
	Minimum Operating Range	Rmin	17.32	feet
	Minimum Operating Range in dB	Rmin_dB	12.39	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**12.00**	feet
	Speed of Light	Cf	9.84E+08	feet/sec.
	Wavelength	Lambda	**0.168248**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*PI	F_PI	10.99	dB
RSU	Antenna Elevation Beamwidth (Hor. to Ang_min)	RSU_el	60.00	degrees
	Antenna Azimuth Beamwidth	RSU_az	13.11	degrees
	Antenna Gain	RSU_g	16.49	dB
	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	1.49	dB
	Minimum Received Signal Level (at receiver)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant.)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant.)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant.)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

CALCULATION OF RE-USE DISTANCE BETWEEN INTERSECTION BEACONS (CONTINUED)

RSU Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	18.33	dBm
	Transmit Power for Successful Uplink	Pt_u	17.65	dBm
	Transmit Power for Up and Down Link	Pt	18.33	dBm
	Transmit EIRP	RSU_EIRP	34.82	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-27.42	dBm

Uplink on Uplink Separation Distance OBU to RSU Antennas

	SCENARIO	Sidelobe	Mainlobe	UNITS
	Same Channel	502.78	2,827.35	feet
	Adjacent Channel	63.30	355.94	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

	SCENARIO	Sidelobe	Mainlobe	UNITS
	Tone to Lower Uplink Band	78.04	2,467.87	feet
	Tone to Upper Uplink Band	78.04	2,467.87	feet
	Tone to Adjacent Channel	7.80	246.79	feet
	Class A: Modulated to Lower Uplink Band	780.41	24,678.69	feet
	Class A: Modulated to Upper Uplink Band	78.04	2,467.87	feet
	Class A: Modulated to Adjacent Channel	55.25	1,747.12	feet
	Class B: Modulated to Lower Uplink Band	246.79	7,804.09	feet
	Class B: Modulated to Upper Uplink Band	78.04	2,467.87	feet
	Class B: Modulated to Adjacent Channel	24.68	780.41	feet
	Class C: Modulated to Lower Uplink Band	78.04	2,467.87	feet
	Class C: Modulated to Upper Uplink Band	78.04	2,467.87	feet
	Class C: Modulated to Adjacent Channel	7.80	246.79	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

	SCENARIO	Sidelobe	Mainlobe	UNITS
	Same Channel	131.12	737.37	feet
	Tone - Adjacent Channel	0.01	0.07	feet
	Class A: Modulated - Adjacent Channel	0.09	0.52	feet
	Class B: Modulated - Adjacent Channel	0.04	0.23	feet
	Class C: Modulated - Adjacent Channel	0.01	0.07	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO		VALUE	UNITS
N/A	Same Channel		0.84	feet
	Adjacent Channel		0.11	feet

APPENDIX D-2
INTERSECTION BEACONS WITH 100' OPERATING RANGE
CALCULATIONS OF MINIMUM SEPARATION DISTANCES

CALCULATION OF RE-USE DISTANCE BETWEEN INTERSECTION BEACONS

General Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**5.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**100.00**	feet
	Minumum RSU Ant. Angle From Vertical	Ang_min	**30.00**	degrees
	Minimum Lateral Separation Distance	Sep_min	8.66	feet
	Maximum Operating Range	Rmax	101.12	feet
	Maximum Operating Range in dB	Rmax_dB	20.05	dB feet
	Minimum Operating Range	Rmin	17.32	feet
	Minimum Operating Range in dB	Rmin_dB	12.39	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**12.00**	feet
	Speed of Light	Cf	9.84E+08	feet/sec.
	Wavelength	Lambda	**0.168248**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*PI	F_PI	10.99	dB
RSU	Antenna Elevation Beamwidth (Hor. to Ang_min)	RSU_el	60.00	degrees
	Antenna Azimuth Beamwidth	RSU_az	6.79	degrees
	Antenna Gain	RSU_g	19.35	dB
	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	4.35	dB
	Minimum Received Signal Level (at receiver)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Mimimum Received Signal Level (0 dB ant.)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant.)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant.)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

CALCULATION OF RE-USE DISTANCE BETWEEN INTERSECTION BEACONS (CONTINUED)

RSU Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	21.21	dBm
	Transmit Power for Successful Uplink	Pt_u	23.42	dBm
	Transmit Power for Up and Down Link	Pt	23.42	dBm
	Transmit EIRP	RSU_EIRP	42.77	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-19.46	dBm

Uplink on Uplink Separation Distance OBU to RSU Antennas

	SCENARIO	Sidelobe	Mainlobe	UNITS
	Same Channel	698.65	3,928.78	feet
	Adjacent Channel	87.95	494.60	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

	SCENARIO	Sidelobe	Mainlobe	UNITS
	Tone to Lower Uplink Band	270.97	8,568.85	feet
	Tone to Upper Uplink Band	270.97	8,568.85	feet
	Tone to Adjacent Channel	27.10	856.89	feet
	Class A: Modulated to Lower Uplink Band	2,709.71	85,688.54	feet
	Class A: Modulated to Upper Uplink Band	270.97	8,568.85	feet
	Class A: Modulated to Adjacent Channel	191.83	6,066.28	feet
	Class B: Modulated to Lower Uplink Band	856.89	27,097.10	feet
	Class B: Modulated to Upper Uplink Band	270.97	8,568.85	feet
	Class B: Modulated to Adjacent Channel	85.69	2,709.71	feet
	Class C: Modulated to Lower Uplink Band	270.97	8,568.85	feet
	Class C: Modulated to Upper Uplink Band	270.97	8,568.85	feet
	Class C: Modulated to Adjacent Channel	27.10	856.89	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

	SCENARIO	Sidelobe	Mainlobe	UNITS
	Same Channel	327.65	1,842.49	feet
	Tone - Adjacent Channel	0.03	0.18	feet
	Class A: Modulated - Adjacent Channel	0.23	1.30	feet
	Class B: Modulated - Adjacent Channel	0.10	0.58	feet
	Class C: Modulated - Adjacent Channel	0.03	0.18	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO		VALUE	UNITS
N/A	Same Channel		0.84	feet
	Adjacent Channel		0.11	feet

APPENDIX E
BUS STOP BEACONS
CALCULATIONS OF MINIMUM SEPARATION DISTANCES

CALCULATION OF RE-USE DISTANCE BETWEEN BUS STOP BEACONS

General Operating Parameters

LOCATION	PARAMETER	LABEL	VALUE	UNITS
General	Center Frequency	Fc	**5.85**	GHz
	Height of RSU Antenna	RSU_h	**20.00**	feet
	Height of OBU Antenna	OBU_h	**12.00**	feet
	Maximum Lateral Separation Distance	Sep_max	**4.00**	feet
	Minimum Lateral Separation Distance	Sep_min	8.00	feet
	Maximum Operating Range	Rmax	8.94	feet
	Maximum Operating Range in dB	Rmax_dB	9.52	dB feet
	Minimum Operating Range	Rmin	**5.00**	feet
	Minimum Operating Range in dB	Rmin_dB	6.99	dB feet
	Width of Antenna Beam at Longest Range	Wmax	**5.00**	feet
	Speed of Light	Cf	9.84E+08	feet/sec.
	Wavelength	Lambda	**0.168248**	feet
	Wavelength in dB	Lambda_dB	**-7.74**	dB feet
	4*PI	F_PI	10.99	dB
RSU	Antenna Elevation Beamwidth	RSU_el	31.23	degrees
	Antenna Azimuth Beamwidth	RSU_az	31.23	degrees
	Antenna Gain	RSU_g	15.56	dB
	Antenna Radiation Pattern Loss	RSU_gl	**3.00**	dB
	Minimum Loss Through Antenna Sidelobes	RSU_sl	**15.00**	dB
	Maximum Antenna Gain Through Sidelobes	RSU_gsl	0.56	dB
	Minimum Received Signal Level (at receiver)	RSU_mrsl	**-94.00**	dBm
	Maximum Interference Signal Level	RSU_int	**-114.00**	dBm
	Isolation Tone to Lower Uplink Band	RSU_TL	**60.00**	dB
	Isolation Tone to Upper Uplink Band	RSU_TU	**60.00**	dB
	Isolation Tone to Adjacent Channel	RSU_TA	**80.00**	dB
	Class A: Isolation Modulated to Lower Uplink	RSU_AML	**40.00**	dB
	Class A: Isolation Modulated to Upper Uplink	RSU_AMU	**60.00**	dB
	Class A: Isolation Modulated to Adjacent Channel	RSU_AMA	**63.00**	dB
	Class B: Isolation Modulated to Lower Uplink	RSU_BML	**50.00**	dB
	Class B: Isolation Modulated to Upper Uplink	RSU_BMU	**60.00**	dB
	Class B: Isolation Modulated to Adjacent Channel	RSU_BMA	**70.00**	dB
	Class C: Isolation Modulated to Lower Uplink	RSU_CML	**60.00**	dB
	Class C: Isolation Modulated to Upper Uplink	RSU_CMU	**60.00**	dB
	Class C: Isolation Modulated to Adjacent Channel	RSU_CMA	**80.00**	dB
OBU	Antenna Gain (35 degrees off boresight)	OBU_g	**4.00**	dB
	Minimum Loss Through Antenna Sidelobes	OBU_sl	**15.00**	dB
	Mimimum Received Signal Level (0 dB ant.)	OBU_min	**-40.00**	dBm
	Maximum Received Signal Level (0 dB ant.)	OBU_max	**-14.00**	dBm
	Maximum Interference Signal Level (0 dB ant.)	OBU_int	**-60.00**	dBm
	Maximum Transmit EIRP	OBU_Pmax	**-24.00**	dBm
	Windscreen Loss, One-Way	L_w	**3.00**	dB
	Modulation Loss	L_m	**3.00**	dB
	Realization Margin	L_r	**4.00**	dB
	RF Amplifier Gain	OBU_rf	**10.00**	dB
	Minimum Conversion Gain	OBU_Gain	5.00	dB
	Adjacent Channel Isolation	OBU_AI	**18.00**	dB

CALCULATION OF RE-USE DISTANCE BETWEEN BUS STOP BEACONS (CONTINUED)

RSU Required Transmit Power Calculations

LOCATION	PARAMETER	LABEL	VALUE	UNITS
RSU	Transmit Power for Successful Downlink	Pt_d	3.94	dBm
	Transmit Power for Successful Uplink	Pt_u	-11.13	dBm
	Transmit Power for Up and Down Link	Pt	3.94	dBm
	Transmit EIRP	RSU_EIRP	19.50	dBm
OBU	Max. Received Signal Level (0 dB ant.)	OBU_Rmax	-31.95	dBm

Uplink on Uplink Separation Distance OBU to RSU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Same Channel		57.19	feet
	Adjacent Channel		7.20	feet

Downlink on Uplink Separation Distance RSU to RSU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Tone to Lower Uplink Band		12.01	feet
	Tone to Upper Uplink Band		12.01	feet
	Tone to Adjacent Channel		1.20	feet
	Class A: Modulated to Lower Uplink Band		120.09	feet
	Class A: Modulated to Upper Uplink Band		12.01	feet
	Class A: Modulated to Adjacent Channel		8.50	feet
	Class B: Modulated to Lower Uplink Band		37.98	feet
	Class B: Modulated to Upper Uplink Band		12.01	feet
	Class B: Modulated to Adjacent Channel		3.80	feet
	Class C: Modulated to Lower Uplink Band		12.01	feet
	Class C: Modulated to Upper Uplink Band		12.01	feet
	Class C: Modulated to Adjacent Channel		1.20	feet

Downlink on Downlink Separation Distance RSU to OBU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
Sidelobe	Same Channel		4.00	feet
	Tone - Adjacent Channel		0.00	feet
	Class A: Modulated - Adjacent Channel		0.00	feet
	Class B: Modulated - Adjacent Channel		0.00	feet
	Class C: Modulated - Adjacent Channel		0.00	feet

Uplink on Downlink Separation Distance OBU to OBU Antennas

RSU ANT.	SCENARIO	LABEL	VALUE	UNITS
N/A	Same Channel		0.11	feet
	Adjacent Channel		0.01	feet